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Operational Availability Handbook Volume I

An Introduction

December 29, 1987

Enclosure (1)

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VOLUME I

INTRODUCTION TO OPERATIONAL AVAILABILITY

PERSPECTIVE

This handbook has been developed to address a critical consideration in the design, development, and deployment of a weapon system. Operational Availability (Ao) is an index of material readiness and is viewed both in terms of readiness requirements and demonstrated performance.

This handbook contains separate volumes with each addressing those key perspectives. Volume II is directed to the office or individual responsible for establishing the material readiness requirement, and Volume III is directed at the office or individual responsible for developing a weapon system, including its support system, which can satisfy the requirement.

Background: Why Ao?

Even though developed in the 1970's under DoD/Navy Integrated Logistic Support (ILS) concepts, major weapon systems entered the fleet and encountered severe readiness and logistic problems. ILS appeared to exist in policy only. In many cases, the fleet did not receive it. "Get well" efforts for newly deployed systems were consuming funds intended for more advanced systems. To determine why the Navy had ILS policy but did not have ILS products in the fleet, a Logistic Review Group (LRG) was created under the auspices of the Chief of Naval Material.

Now under OP-04 cognizance, the LRG reviews the adequacy of ILS of major programs prior to each major acquisition milestone. Per recent direction of the Chief of Naval Operations (CNO), they also review programs prior to Fleet Introduction/Initial Operational Capability. The LRG assesses material readiness in terms of requirements, plans, resources, and demonstrated achievement.

In their earliest ILS audits, the LRG found that there was no common approach to setting and evaluating material readiness requirements. The LRG further found that programs generally lacked any substantive link between their readiness requirements, the reliability levels specified by contract, and their logistic resources and planning necessary to achieve the required readiness in the fleet.

Principally as a result of the early findings of the LRG, Ao was adopted as the primary measure of material readiness in the Navy. Appendix A provides the chronology by which Ao has been incorporated into policy directives and instructions.

What is Ao?

The operational availability (Ao) of a system is the probability that the system is ready to perform its specified function, in its specified operational environment, when called for at a random point in time.

Although explicit, the above definition needs quantification in order to measure and analyze either Ao requirements or demonstrate performance. Appendix B provides a detailed mathematical discussion of the above definition.

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Why is Ao Important?

Ao is a key consideration in system acquisition and operation for two basic reasons.

Ao is a key element of system effectiveness. System effectiveness is determined by the combined effects of the system's operational availability, dependability, and capability. Figure I-1 depicts the conceptual relationship of these factors in layman's terms. Operational capability refers to the system's operating characteristics (range, payload, accuracy, and the resultant ability to counter the threat). Operational dependability refers to the probability that the system, if up at the beginning of the mission, will remain up throughout the mission. Capability, availability and dependability must be defined relative to the specific warfare environment and operating scenario envisioned or employed for a given system. Combined, they determine system effectiveness (SE). The system effectiveness of a specific system in part determines the effectiveness of the ship or aircraft platform on which it is installed.

Ao requirements drive logistic support requirements and ownership costs. Ao is determined by the level of reliability and maintainability inherent in the design of a specific system and the logistic resources needed to achieve a desired level of operational readiness. When only inherent reliability and maintainability are considered, the result is inherent availability (Ai). Because inherent reliability and maintainability (R&M) create downtime in operational use, logistic resources must be applied in increasing levels to limit additional downtime due to "real world" logistic delays. When logistic delays are considered together with reliability and maintainability, the result is operational availability (Ao). The focus of this handbook is Ao.

NAVY POLICY SUMMARIZED

It is Navy policy that Ao shall be the Primary measure of material readiness for weapon systems and equipment. An Ao threshold is required to be assigned for each system and equipment, and logistic support systems are required to be designed to achieve the assigned threshold. Funding profiles are required to be quantitatively linked to Ao thresholds.

The requirement to establish Ao thresholds for systems is applicable early in the acquisition process. A tentative Ao threshold (in terms of a range of potentially acceptable Ao values) should be established in the Mission Need Determination phase of acquisition. The Ao requirement should then be stated as a:

Tentative Ao threshold -- level or range of Ao desired to meet the expected threat in the operating environment envisioned for the system.

This tentative Ao threshold should be based on preliminary estimates of the system's performance requirements and the expected R&M, and the character and quantity of logistic support anticipated for the system. As the system design is better defined, the data needed to estimate detailed maintainability and logistic support requirements will become more accurate.

As the acquisition process proceeds, the initial estimates of required Ao can be more firmly established. At Milestones 0 and I, preliminary Ao thresholds are required.

Preliminary Ao threshold -- a level of Ao that is adequate to meet the threat and potentially achievable in view of current and emerging technology and the logistic support for similar, existing systems.

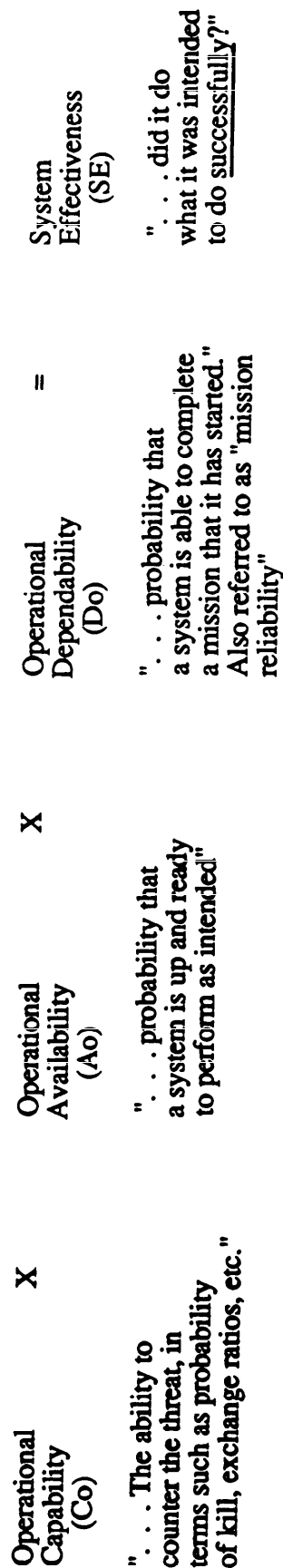


FIGURE I-1: SYSTEM EFFECTIVENESS*

* For a more academic discussion of System Effectiveness and related terminology refer to Reliability Engineering, William H. Von Alven, ARINC Research Corp., (New Jersey: Prentice-Hall, Inc., 1964) This is one good reference; there are many others.

By Milestone II, the preliminary Ao thresholds established for Milestones 0 and I will be validated or revised to reflect a firm Ao threshold.

Firm Ao threshold--a level of Ao required to be achieved when the system is deployed. System design features and logistic support plans and resources must be adequate to satisfy the requirement.

RESPONSIBILITIES SUMMARIZED

The CNO is responsible for setting Ao requirements. The CNO Resource Sponsor (usually in OP-02, OP-03, OP-094, or OP-05) is responsible for assigning, monitoring, and gaining approval for Ao thresholds and the corresponding program funding per OPNAVINST 5000.49A (NOTAL).

OP-04 assists Resource Sponsors and monitors Ao development to ensure that logistic considerations are adequate.

OP-098 (Director, Research, Development, Test and Evaluation) monitors requirements documentation to ensure that proper readiness objectives have been established and that adequate testing and evaluation are planned.

OP-91 provides oversight and assessment support.

Detailed analysis of Ao requirements, for purposes of translating operational requirements into an appropriate set of technical (specification) requirements, rests with the developing agency and is the chartered responsibility of a Program Manager. The developing agency, together with laboratories and other agencies, provides the technical and logistic expertise to analyze Ao requirements and related operational scenarios, and to develop specifications, plans and budgets to satisfy the operational requirements at the lowest effective life-cycle cost (LCC).

The Program Manager is responsible for all aspects of the program in a management, budget, and operational sense. Per explicit Department of Defense (DoD) and Navy policy, this individual is responsible for considering readiness and support issues equally with cost, schedule, and technical performance. This individual normally continues to monitor and manage the weapon system following fleet introduction and is responsible for ensuring that it meets Ao requirements and mission objectives.

Commander, Operational Test and Evaluation Force (COMOPTEVFOR) tests new systems during Operational Test and Evaluation (OT&E) and Follow-on Test and Evaluation (FOT&E) and reports on the Ao achieved. OPTEVFOR works with the Program Manager to establish a Test and Evaluation Master Plan (TEMP) specifying the conditions under which the system is to be tested.

Table I-1 provides the definition of the different phases of the acquisition process and generally describes the major activities required in each phase. Relevant acquisition directives and standards are highlighted.

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Milestone		I	II	III
Phase	Mission need determination	Concept exploration	Demonstration and validation	Full-scale development
Activities	Identify mission area needs and alternatives analysis	Baseline system analysis Functional baseline development Alternative support concept analysis	System design and operational alternatives analysis Allocated baseline development Firm support concept developed	Detailed mission system and support system Product baseline development Initial support plan prepared; specific logistic resources designed/developed/tested
Directives/Standards*	DODD 5000.1/2/3/39 MIL-STD-1388-1A SECNAVINST 5000.39A 5000.1B/39A OPNAVINST 5000.42B/49A	DODD 5000.39 MIL-STD-1388-1A SECNAVINST 5000.39A OPNAVINST 5000.49A	DODD 5000.39 MIL-STD-1388-1A/2A SECNAVINST 5000.39A OPNAVINST 5000.49A	DODD 5000.39 MIL-STD-1388-1A/2A SECNAVINST 5000.39A OPNAVINST 5000.49A
* Pertinent to material readiness		MIL-STD-721C OPNAVINST 3960.10C	MIL-STD-721C OPNAVINST 3960.10C	MIL-STD-721C OPNAVINST 3960.10C

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Table I-1
Acquisition Process

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THE HANDBOOK

What is the Focus of this Handbook?

This handbook focuses on the roles of the Resource Sponsor in Volume II and the Program Manager in Volume III. Both volumes address the issues of what design requirements, plans, procedures, and resources are required to meet Ao requirements for specified missions. The intended user of this handbook are the Resource Sponsor, Program Manager and their staffs (direct and indirect, military or civilian) for a specific weapon system.

What are the Objectives of this Handbook?

This handbook is intended to guide Program Managers and Resource Sponsors in dealing fundamentally with technical and managerial aspects of quantitatively relating resources to readiness.

Structured specifically to follow the established systems acquisition process, this handbook is a time-phased guide to the initial establishment of Ao requirements, ongoing analysis of plans and resources to satisfy requirements, and the requirements for addressing material readiness issues in weapon system acquisition program documentation.

Examples are used throughout the handbook to provide a general profile of the Program Manager's and Resource Sponsor's responsibilities and those key interfaces, decision points, and management steps in an acquisition program. Obviously, application of the material in this handbook to a specific weapon system's acquisition requires considerable tailoring and adjustment. This handbook will be useful and appropriate to the general case, but it alone will not be sufficient to deal with any specific case. Critical are the particular characteristics of the system design, its failure modes and their effects, system demand patterns, and overall utilization, logistic support considerations, and operational environment.

This handbook is not intended as a technical "how to" discussion. It is not a desktop procedure for a mission requirements analyst, a design engineer, a logistic support analyst, or a test and evaluation analyst. Located typically in the Systems Command (SYSCOM), on the staff of COMOPTEVFOR or the CNO, these individuals must deal with the detailed requirements and methods for a specific project; they require tailored, technical, and often unique methods and procedures to perform their assigned functions. Program Managers and the Resource Sponsors rely on these individuals and should have an appreciation of their roles; their main task is to identify, assess, and document those key elements, decision points, and issues related to Ao that will determine the success of the acquisition effort.

Volumes II and III assume that the reader has had little or no exposure to the details of systems acquisition, logistic support analysis (MIL-STD-1388-1A/2A), the Navy logistics system, modeling, or cost-benefit analysis, and the data base maintained to support these processes or related data bases. It is directed primarily at the individual with an operational background who is a Resource Sponsor or a Program Manager for the first time.

How does this Handbook Relate to Policy?

This handbook does not supersede specific policy or procedural details, but it does relate these policy and procedural details to the broader issues of Program Manager and Resource Sponsor responsibilities and decisions.

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Further, it provides a guide to analysis and decision-making. It is intended to alert all participants in the acquisition process to the implications of existing policy--those key steps, critical milestones, major factors or issues, supporting documentation requirements, and basic questions of data and analysis--that relate to the establishment and the continuing evaluation and support of weapon system material readiness.

How is this Handbook Organized?

This handbook is structured on three levels: (1) by acquisition phase, (2) by functional area of responsibility, and (3) by key action steps.

Acquisition Phase. Consideration of Ao in each phase of the system acquisition process is addressed in a separate chapter for each phase. The rationale for this organization is that the Program Manager and the Resource Sponsor are generally most concerned with the issues, the decisions, the documentation, and the analysis of Ao that are appropriate to the current (or next) phase of the acquisition program. While formal DoD milestone definitions are used, it is recognized that many programs will not undergo a formal review at each milestone. Nevertheless, every program faces decisions that are essentially equivalent to the DoD milestones and should be viewed as such.

Functional Area of Responsibility. Within each phase of acquisition, this handbook discusses three specific areas of responsibility of the Program Manager and the Resource Sponsor:

- Establishing the Ao requirement
- Monitoring and evaluating the Ao requirement and related resource requirements.
- Assessing the cost-benefit tradeoff analyses conducted to support the Ao requirement.

Key Actions. For each area of responsibility noted above in each acquisition phase, this handbook addresses:

- What key actions must be completed?
- What data inputs and outputs are necessary to complete these actions?
- How should the action be completed?
- What documentation is required?

PREVIEW OF VOLUME II.

This volume focuses on the role of the Resource Sponsor and his responsibilities for system acquisition from Pre-Milestone 0 through system deployment and operational use. Emphasis is on setting Ao requirements and programming resources to support those requirements.

PREVIEW OF VOLUME III.

This volume focuses on the role of the Program Manager and his responsibilities for system acquisition from Pre-Milestone 0 through system deployment and operational use. Emphasis is on translating operational requirements to technical (specification) requirements, determining detailed resource requirements and preparing detailed plans for acquisition and support of new systems to satisfy the Ao requirement.